

Pavement Smoothness and Fuel Efficiency: Increased Fuel Costs Heighten the Importance of Transportation Investments

MoDOT Summary Statement

In a 2006 study, the positive affect of pavement smoothness on fuel efficiency was confirmed for Missouri drivers on Interstate 70. Specifically, the study examined the miles per gallon in fuel savings for smooth versus rough pavement. After nearly two years since the resurfacing and original study, the economic impacts of the Smooth Roads Initiative have nearly doubled due to increased fuel costs.

A revisit of the original study based on current road smoothness, large truck volumes and increased fuel prices demonstrates that quality pavements continue to deliver savings for drivers. Current research indicates that the pavement smoothness has not significantly changed, and based on increased diesel fuel prices averaging \$4.70 per gallon, savings to large trucks increased from \$7,989,120 per year in the original study to \$14,667,525 per year with increased fuel costs.



Figure 1, Interstate 70 Pavements Before and After Pavement Resurfacing.

MoDOT Project Overview

Previous research has confirmed a relationship between smooth roads and fuel efficiency¹. And although this research has had significant variations in results and conditions, the majority of the research supports a positive relationship between smoother road surfaces and greater fuel efficiency. Smooth roads lead to lower rolling resistance and thus greater fuel efficiency.



¹ WesTrack Track Roughness, Fuel Consumption, and Maintenance Costs. Research, Development and Technology, Turner-Fairbank Highway Research Center. January 2000

MoDOT Project Overview (cont'd.)

MoDOT's original study was set up to test real conditions in Missouri and compare dump truck fuel efficiencies on a pavement before and after pavement resurfacing. The large dump trucks are considered a proxy for 18-wheeled tractor-trailers. MoDOT staff drove four, specially instrumented dump trucks on a 22-mile loop of I-70, in Lafayette County, east of Odessa. Before resurfacing, each vehicle was driven more than 50 hours and more than 2,000 miles on the test loop at a target speed of 60 miles per hour. This was repeated after resurfacing.

"Before paving" loops were driven in May 2006, while the "after paving" loops were driven in September and October 2006.



Figure 2, MoDOT Test Truck on I-70 Prior to Pavement Resurfacing.

The International Roughness Index was used as a proxy for pavement smoothness and was measured with the Automated Road Analyzer (ARAN) van. The average International Roughness Index (IRI) before paving was "poor" at 130. After paving, the pavement IRI was considered smooth at 60. This represents more than 53 percent improvement in smoothness. Complete research methods and findings from the original report can be found at: <http://168.166.124.22/RDT/reports/Ri05040/or07005.pdf>

In the original study, a 53 percent improvement in road smoothness, as part of the Smooth Roads Initiative, resulted in a 2.46 percent improvement in miles per gallon for large trucks. With approximately 9,000 large trucks per day on I-70, over the course of a year the annual fuel savings would be 3,120,750 gallon of diesel. At the Nov. 16, 2006 average price per gallon of \$2.56, the annual cost savings would be \$7,989,120.

Currently, pavement smoothness as rated by IRI remains near 60, with ratings as low as 58 as compared to previous pre-study ratings of 130 and post resurfacing ratings of 60. For practical purposes and from the driver and fuel consumption perspectives, pavement smoothness remains unchanged. Current large truck volumes remain near 9,000 vehicles per day. What has changed, as we are all aware, are fuel prices. With an increase greater than 77% in Midwest diesel fuel prices, the savings related to the smoother surface and decreased rolling resistance have increased proportionately. A change in the on-road diesel prices from \$2.56 per gallon in November of 2006 to \$4.70 in July of 2008 means that savings from the improved road smoothness increase from over \$7 million a year to over \$14 million a year.

MoDOT Project Overview (cont'd.)

With current fuel prices, smooth roads mean that \$14 million remain available to drivers and companies. There are \$14 million that are not spent on fuel that then can be invested in business growth, operations, or in salaries. These very real dollars remain available as the capital and profit that drives the American economy.

In contrast, as our ability to construct and maintain transportation facilities decreases with reduced transportation funding, these efficiencies will be lost. The decreased efficiencies are likely to result in more rapid cost increases in other consumer goods as the additional fuel costs are passed onto the consumer.

Conclusions

Smooth roads make sense in Missouri.

Previous research tells us that rough highways cost us money in increased vehicle operating costs. The non-profit organization, TRIP, estimates that driving on roads in need of repair costs the average urban driver \$383 each year.² Missouri's advanced planning process and statewide customer satisfaction surveys indicate customers want a smooth ride. In fact, it's not too much of a stretch to suggest that customer satisfaction with ride quality is equal to overall satisfaction with MoDOT. Additionally, these transportation investments provide secondary benefits as they move across the economy. Investments in major roads such as I-70 return over \$4 for every dollar invested, provide an additional 1,770 jobs per year and result in an additional \$58 million dollars in personal income.

Savings add up! The Smooth Roads Initiative on I-70 is only a little over 10 percent of the Smooth Roads Initiative (based on miles of pavement). So these small savings add up, especially as fuel costs continue to rise. The efficient management of our transportation system creates tremendous cost efficiencies – literally saving travelers millions of dollars per year - at least \$14 million at current fuel prices for tractor-trailers on I-70 alone.



Figure 4, Close-up of Pavements Before and After Resurfacing.

²<http://www.tripnet.org/RoughRideReportOct2006.pdf>

³http://www1.eere.energy.gov/vehiclesandfuels/pdfs/program/21ct_roadmap.pdf